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ABSTRACT

This paper uses multiple linkage analysis to identify greater than expected out-migration flows (salient flows or links) from State Economic Areas (SEAs) within the southeastern United States for two time periods, 1955-60 and 1965-70. In addition, the number of salient flows per SEA are compared with selected characteristics of the SEA, such as population size, relative location, distance travelled by migrants between SEAs, and the metropolitan or nonmetropolitan character of SEAs. This was done to determine if associations could be established between the occurrence and frequency of salient flows and characteristics of the SEAs, in both SEAs of origin and SEAs of destination. Results indicate that the number of links generated by SEAs of origin were related to elements outside of the SEA of origin. The number of links generated by the SEAs of destination related to the SEA of destination's population size and metropolitan character. (CMG)

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SALIENT MIGRATION FLOWS IN THE SOUTHEASTERN UNITED STATES: 1955-1960 AND 1965-1970 by James F. Fryman, University of Northern Iowa, Cedar Falls 50614

This paper identifies greater than expected out-migration flows (salient flows) from State Economic Areas (SEA) within the southeastern United States for two time periods, 1955-1960 and 1965-1970. In addition the number of salient flows per SEA are compared with selected characteristics of the SEA, such as population size, relative location, distance between SEAs and the metropolitan character of SEAs. This was done to determine if associations could be established between the occurrence and frequency of salient flows and characteristics of the SEAs. Multiple linkage analysis was used to identify greater than expected migration flows.

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SALIENT MIGRATION FLOWS IN THE SOUTHEASTERN UNITED STATES: 1955-1960 AND 1965-1970 by James F. Fryman, University of Northern Iowa, Cedar Falls, Iowa 50614. Paper given at the Annual Meeting of the Association of American Geographers, April 27, 1983, Denver, Colorado.

The purpose of this paper was to identify, map, and analyze out-migration flows judged to be greater than expected from each of the 133 State Economic Areas (SEA) located within the southeastern United States (Fig. 1). Once the determination was made as to which of the migration flows met the criteria of "greater than expected" an attempt was made to determine if certain characteristics of the SEA were related to the occurrence and frequency of these salient flows.[1] The characteristics of the State Economic Areas that were thought to be related to salient flows occurrence were population size of the SEA, the relative location of the SEA (primarily the number of contiguous units or joins each SEA has with its neighbors), distance between SEAs and whether an SEA is classified as metropolitan or non-metropolitan.

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Figure I About Here
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The ten state southeastern United States region was selected because it was large enough to allow pattern development and contained enough cases for analysis yet did not pose a problem in data handling. Two time periods were examined to check on consistence of findings and to establish possible trends. Where possible all of the 133 SEAs were utilized in analysis but in some instances, such as distance analysis, only the 46 Metropolitan State Economic Areas (MSEA) were used.

In examining all out-migration flows within the Southeast it was found that each varied in terms of the total volume of out-migration and also in the percentage of the total out-migration contained within the primary or

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largest out-migration flow. In some cases the percentage of an SEA's largest out-migration flow was three to four times greater than the next largest migration flow, while in other cases the primary out-migration link was only slightly larger in population than the next largest migration flow. The first consideration in this paper was to determine which out-migration flows were significantly larger than expected. Once the salient links were identified they were then mapped to display linkage patterns and frequency of occurrence among the units and also to identify the terminus or destination units of each flow.

Methodology

Initially, a number of methods for identifying greater than expected out-flows were considered. Multiple linkage analysis, a statistical method which estimates what the volume of flow will be from each origin SEA to each destination SEA based on the number of destination units, proved to be the best method given the data. The strength of this method was that the generated flows could be compared with the actual flows and a correlation between the expected flows and actual flows derived. The correlation could then be used to determine the saliency of each flow.

This method was derived from a formula orginally used to identify the main crop in a multi-crop area[2] and later modified by Holmes and Haggett to facilitate the use of flow data.[3] Essentially, when applied to migration flows, the statistical method determines the expected out-migration flow based on the number of SEAs within the system and the number of possible destinations. Once the expected volume was determined, a correlation was made between the actual and the expected flows. The flows which were greater than expected were then designated as significant or salient out-migration links from the unit of origin.

The formula used to determine the number of salient links was as follows: all out-migration flows (k) within the migration matrices (133 for the TSEA matrix and 46 for the MSEA matrix) were ranked by volume of migrants from the largest (m_1) to the smallest (m_k). A set of k-cycles of expected flows (m_i) was then generated in the following way:

$$\text{1st cycle: } \hat{m}_1 = \sum_{i=1}^{k} m_i$$

$$\hat{m}_2=\hat{m}_3=\ldots=\hat{m}_k=0$$

$$\text{2nd cycle: } \hat{m}_1=\hat{m}_2=1/2 \sum_{i=1}^{k} m_i$$

$$\hat{m}_3=\hat{m}_4=\ldots\hat{m}_k=0$$

$$\text{jth cycle: } \hat{m}_1=\hat{m}_2=\ldots\hat{m}_1= {}^{1}/_{j} \sum_{i=1}^{k} m_i$$

$$\hat{m}_j=\hat{m}_{j+2}=\ldots\hat{m}_k=0$$

The goodness of fit between the set of observed flows (M) and the sets of expected flows (M_1) $(M_2)\ldots.(M_K)$ is then made. The measure to determine goodness of fit was the coefficient of determination (r^2) of the Pearson product moment correlation. Determination of the closest fit between the observed and expected flows is made by observing when the r^2 between (M) and (M) is at its maximum. That is each set of expected flows is compared with observed flows and a coefficient of correlation is generated. The largest r^2 is selected as the best fit and the preceding flows plus the flow represented by the highest r^2 are considered significant.

Consider the example of Virginia SEA-one (Va-1) the total out-migration flow for Va-1 was 11,778 and the four largest ranked out-migration flows were 1968, 1563, 831, 638. The four largest expected flows were: 11,778 if only one destination unit is present, 5,889 if only two destination units are present, 3,924 if only three destination units are present, and 2,943

if only four destination units are present. This process would continue for all 132 possible destination units, however, it should be noted that the maximum r^2 normally is found relatively soon, well within the top ten largest flows. The maximum number of salient links, seven for Sc-A, was in the 1970 TSEA data set. The Pearson correlation coefficient r^2 between the actual migration flow and the expected set of flows were set 1 - r^2=.685, set 2 - r^2=.744, set 3 - r^2=.711, set 4 - r^2=.631. In this case .744 is the maximum r^2 which represents the second set, so the second and first set would be considered significant.

Testing for associations between the number of salient flows and characteristics of State Economic Areas was accomplished using either Spearman rank correlation or point biserial correlation. Some testing, such as distance traveled, could only be accomplished using Metropolitan SEAs (MSEAs) while others, such as relative location and whether a unit was metropolitan or not, were done using all 133 SEAs.

Migration Patterns

Multiple linkage analysis identified 299 salient out-migration links in 1960 and 319 links in 1970 (Fig. 2 and Fig. 3). Using just the 46 Metropolitan SEAs indicated 71 salient links present in 1960 and a total of 100 links in 1970 (Fig. 4 and Fig. 5). The average number of salient flows was 2.24 flows per SEA in 1960 and 2.34 per unit in 1970 for the entire Southeast and 2.21 per unit in 1960 and 2.28 per unit in 1970 for the MSEAs. The vast majority of salient flows connected with other SEAs within the respective state border (80.5 percent 1960 TSEA, 91.6 percent 1970 TSEA, 62 percent MSEA 1960 and 69.0 percent 1970 MSEA). In addition, the average length of the MSEA salient links was relatively short, 153 miles in 1960 and 168 miles in 1970. Average length of salient flows for the 133 SEA data

set was impossible to calculate since non-metropolitan SEAs are sometimes composed of two non-contiguous areas and are irregularly shaped.

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Figures 2, 3, 4 and 5 About Here
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Salient Flows and Enviromental Associations

The following analysis was based on the assumption that the occurrence of salient migration flows at the origin SEA and the number of salient flows terminating in a destination SEA could be explained by certain attributes of SEAs. The characteristics were grouped into four categories: population size of the SEA, relative location of the SEA, whether an SEA was classified as metropolitan or non-metropolitan, and the distance traveled by migrants within the salient link.

A series of hypotheses examined the number of salient flows at the origin unit, the destination unit and the characteristics of the salient flows themselves. The origin and destination units were both used because it was not certain whether characteristics of the origin were associated with variations in the number of salient links or whether characteristics of the destination unit was the primary factor in determining the number of salient links.

A number of hypotheses were tested using Spearman rank correlation, point biserial correlation, or percentage comparisons. The general findings are as follows.

First, for the unit of origin, correlation analysis indicated that no significant relationship existed between the number of salient out-migration links and any of the following characteristics of the origin unit: population size, population density, the number of contiguous units, net migration rates, and the metropolitan or non-metropolitan nature of the unit. (Table 1)

Second, significant positive correlations were established between the average length of salient out-migration flows and both the population size (TSEA and MSEA) and the number of salient links out of the unit of origin.

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TABLE I About Here
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Overall, it was concluded that the numer of salient links generated by SEAs of origin were related to elements outside of, or unrelated to, the unit origin. The characteristics of the unit of destination may well have had more to do with the number of salient migration links than those of the origin SEA.

Several associations were established from correlation analysis of characteristics of the destination unit and salient in-migration links. (TABLE II) First, there was a positive relationship between the number of in-migration links and population size, population density, the average length of salient flows, and the metropolitan characteristics of an SEA. Second, percentage comparisons indicated that the majority of salient migration flows did link with units having a greater population than the origin unit and that salient flows tended to link with units within state boundaries. Third, there appeared to be no relationship between the number of in-migration links and the number of SEAs which were contiguous to the destination units. However, percentage comparisons showed that most salient flows did link with contiguous units. Even though proximity could not account for either the generation or attraction of salient migration flows, it appeared that most flows did travel to contiguous units.

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TABLE II About Here
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Overall, these results, compared to the analysis of origin units,

indicated a considerable effect of the characteristics of the unit of destination on the number of migration links into that unit. Population size in particular and also accessibility and metropolitan characteristics of units of destination all seemed to be related to the number of salient migration links which enter the destination SEA.

Conclusions

The multiple linkage analysis method of identifying salient migration links was instrumental in delimiting major migration paths within the Southeastern United States. In addition the creation of salient migration links allowed for the determination of whether characteristics of the origin and/or destination SEA were most associated with the number and pattern of salient links. Hypothesis testing using population variables, whether an SEA was metropolitan and the number of contiguous SEA indicated that the destination SEA was most associated with the occurrence of salient links. More specifically population size and the fact that an SEA was metropolitan were most associated with the destination unit.

While the multiple linkage analysis method in this paper is specifically dealing with inter-SEA migration it also has utility in examining trait specific migration patterns such as college migration and retirement flows. In addition to migration the method has applicability to other flow data such as transportation and communication.

Footnotes

[1]Salient links will be the term used to indicate greater than expected out-migration flows from units of origin. A more detailed explanation of salient linkage analysis will be found under the methods section of this paper.

[2]J. C. Weaver, "Crop Combination Regions in the Middle West," Geographical Review 44 (1954): 175-200.

[3]J. H. Holmes and P. Haggett, "Graph Theory Interpretation of Flow Matrices," a Note on Maximization Procedures for Identifying Significant Links, University of Queensland, Mimeographed, 1975.

TABLE I

SPEARMAN RANK CORRELATIONS*

	ORIGIN			
	TSEA 1960	TSEA 1970	MSEA 1960	MSEA 1970
Population	-0.39	-0.13	0.10	0.31
Population Density	0.01	-.017	--	--
Contiguous SEAs	0.01	0.04	--	--
Average Length	--	--	0.50	0.54
Metropolitan** Character	+.0086	-.0406	--	--

*Only correlation coefficients with significance levels of .0005 or less were reported
**Point Biserial Correlation

TABLE II

SPEARMAN RANK CORRELATIONS*

	DESTINATION			
	TSEA 1960	TSEA 1970	MSEA 1960	MSEA 1970
Population	0.70	0.65	0.84	0.72
Population Density	0.35	0.35	--	--
Contiguous SEAs	0.01	0.01	--	--
Average Length	--	--	0.78	0.86
Metropolitan** Character	+.31630	+.26383	--	--

*Only correlation coefficients with significance levels of .0005 or less were reported
**Point Biserial Correlation

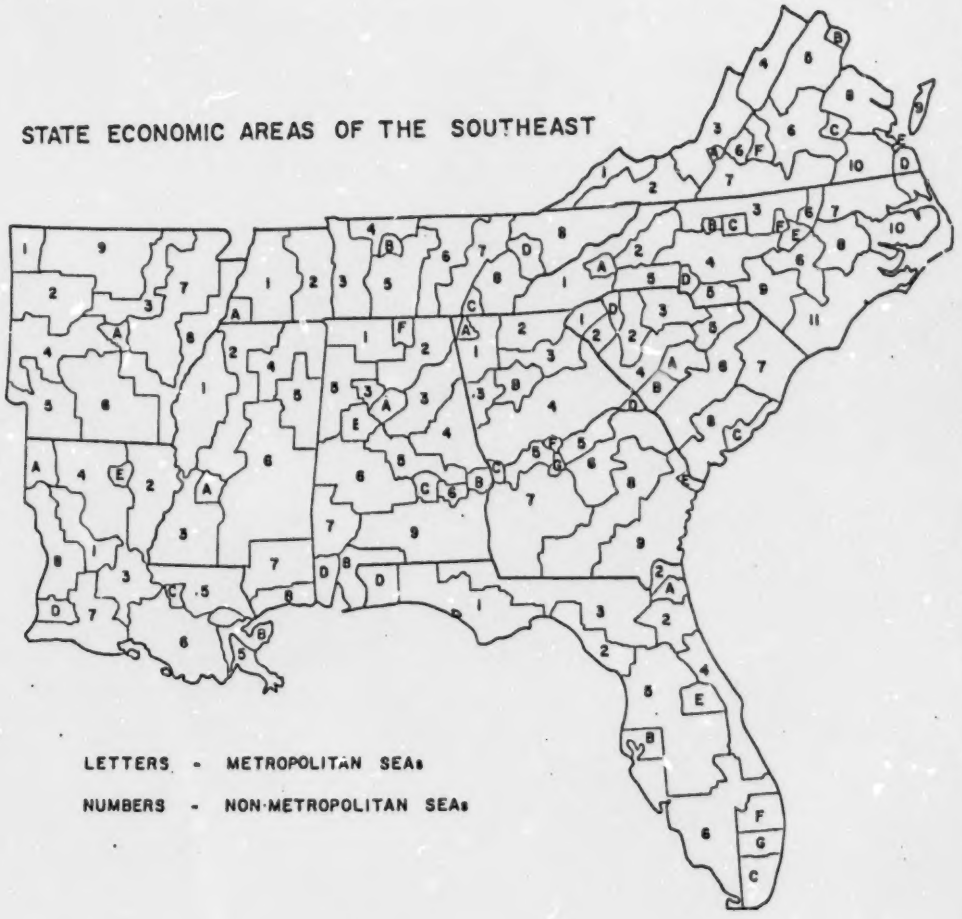
STATE ECONOMIC AREAS OF THE SOUTHEAST
LETTERS - METROPOLITAN SEAs
NUMBERS - NON-METROPOLITAN SEAs

Figure 1

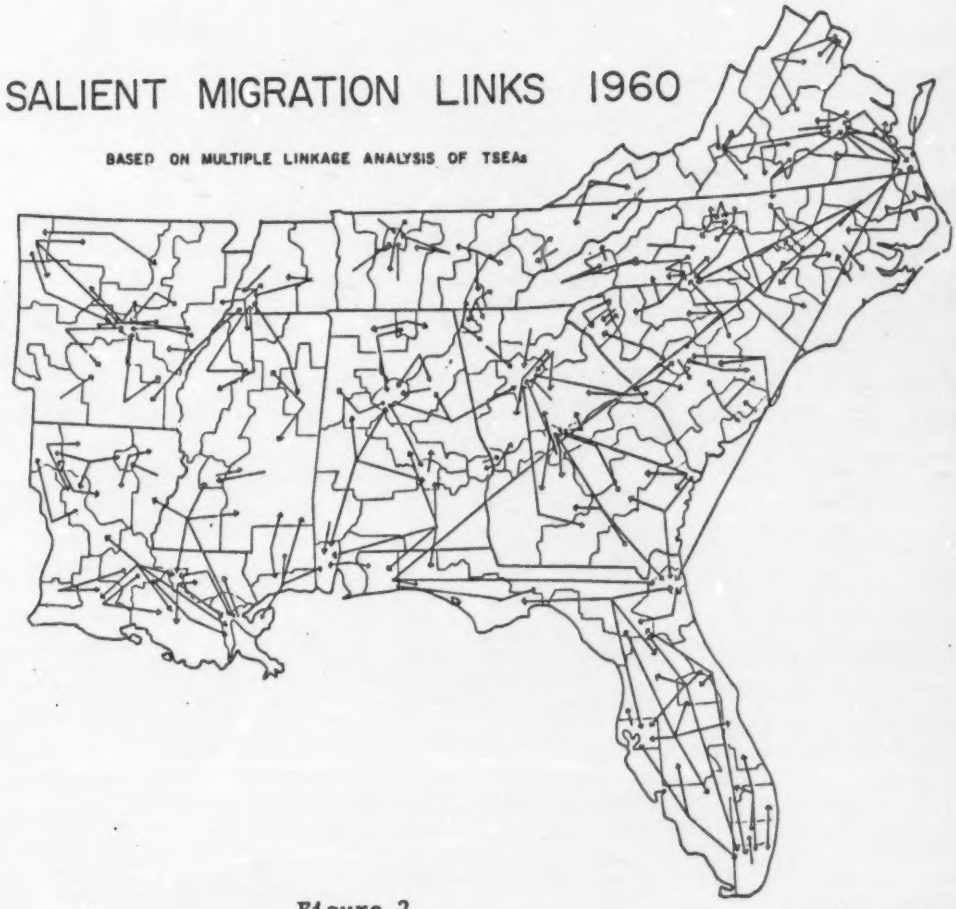
SALIENT MIGRATION LINKS 1960
BASED ON MULTIPLE LINKAGE ANALYSIS OF TSEAs

Figure 2

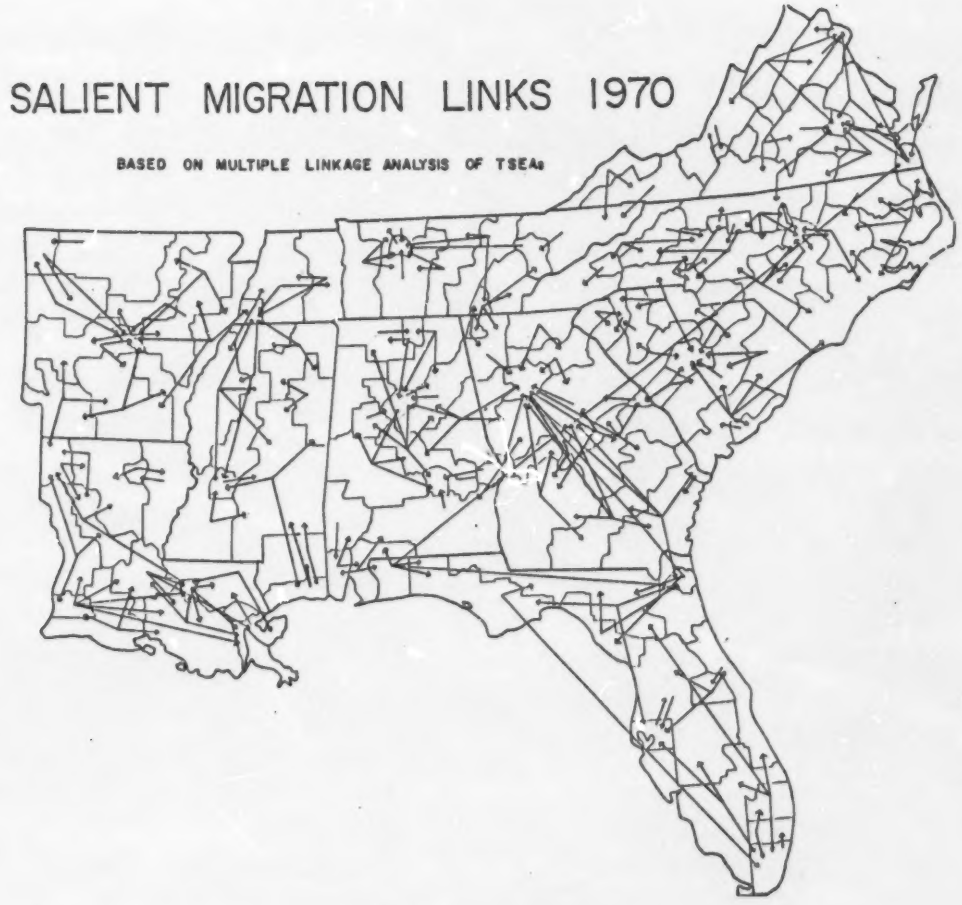
SALIENT MIGRATION LINKS 1970
BASED ON MULTIPLE LINKAGE ANALYSIS OF TSEAs

Figure 3

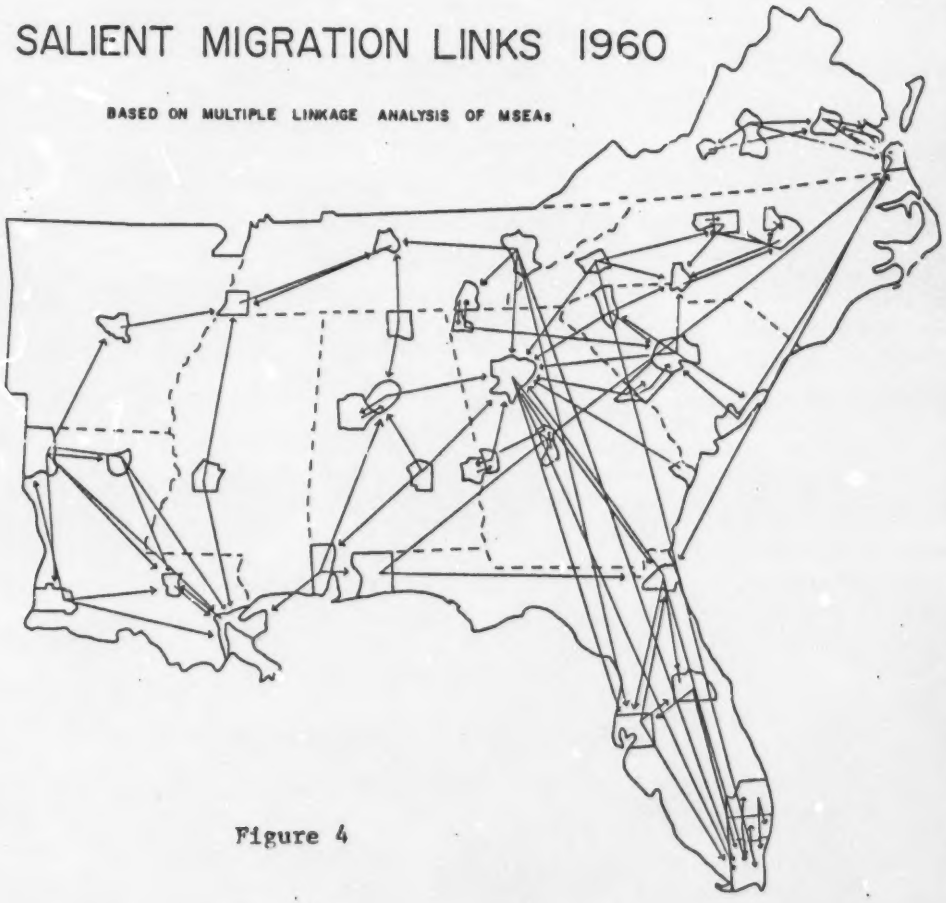
SALIENT MIGRATION LINKS 1960
BASED ON MULTIPLE LINKAGE ANALYSIS OF MSEAs

Figure 4

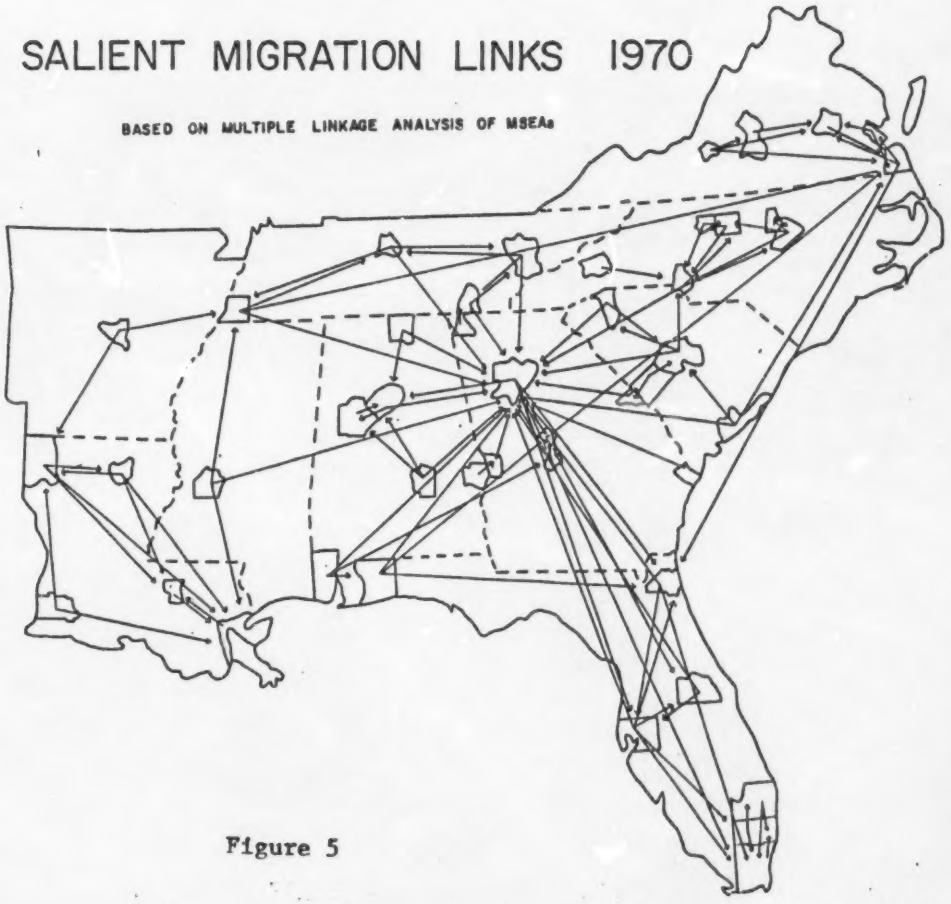
SALIENT MIGRATION LINKS 1970
BASED ON MULTIPLE LINKAGE ANALYSIS OF MSEAs

Figure 5